Engineering

Syllabus 2022-2023

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Room: Science 123

Course Overview: Engineer Your World is a one-year high school engineering curriculum developed by the Cockrell School of Engineering at University of Texas at Austin in collaboration with the National Science Foundation and NASA. This hands-on, project-based course emphasizes the historic achievements and contemporary challenges of engineers, the engineering design process, and the skills and habits of mind that engineers find most essential in their work.

Our first unit focuses on establishing norms for all of our group interactions and for effective documentation of our projects in our engineering notebooks. The next six units all involve designing, building, and testing devices or systems of devices to accomplish specific tasks in response to customer needs. Each unit also emphasizes several specific aspects of the work of professional engineers. The remaining units are: 2. Pinhole Cameras (Discovering Design), 3. Piggy Flashlights (Reverse Engineering and Redesign), 4. Designing Coffee (Understanding Data), 4. Earthquake Simulator (Designing with Data), 5. Programming Electronic Music (Microprocessors), and 6. Aerial Imaging (Systems).

Next Generation Science Standards (NGSS) Skills:

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analysis and interpretation of data
- Using mathematics and computational thinking
- Constructing explanations and designing solutions
- Engaging in arguments based on evidence
- Obtaining, evaluating, and communicating information

Unit Study Overview:

Title	Main Science Content
Unit 1: Overview & Norms August Essential Questions: • What constitutes complete and accurate documentation for engineers? • How does such documentation support good engineering design? • How do engineers work effectively in teams?	**Unit 1 Breakdown:** a. Introduction b. Teamwork c. Communication & Documentation d. Applying Our Norms **Assessments:** **Individual/Formal:** Assessment 1 – Teamwork Assessment 2 – Documentation Norms **Group/Formal:** Cardboard car built to assigned instructions Speaking professionally in final presentation Demonstration of car successfully meeting the requirements Class-generated list of technical communication (notebooking) norms Classroom Norms
Unit 2: Discovering Design August/October Essential Questions: • Why is it important to follow a structured design process? • What constitutes complete and accurate design documentation for engineers? • How does such documentation support good engineering design? • How do engineers decide which problems to solve?	**Unit 2 Breakdown:** a. We Need Engineers, Engineers Need Us b. Where Do We Begin? c. Where Do We Begin?, Part II d. Universal Design e. Explore Ideas f. Ideas, Ideas, Ideas g. Which Idea? h. Build the Camera i. Try It Out! j. Document Your Design k. Reflect On Design l. Greatest Achievements **Assessments:** **Individual/Formal:** Assessment 0 – Universal Design Assessment 1 – Optics Assessment 2 – Activities and Functions Assessment 3 – Concept Generation Assessment 4 – Design Embodiment Assessment 5 – Verification Assessment 6 – Documentation Assessment 7 – Engineering Design Process Assessment 8 – Design Evolution Assessment 9 – Engineering Achievements Peer Assessment Self-Assessment

	Group/Formal: Completed pinhole camera A technical report for manufacturing that includes drawings, instructions, specification documents and test plans End-user instructions
Unit 3: Reverse Engineering October/December Essential Questions: • What is the relationship between engineers and customers? • How do the needs of potential customers impact the design of a product? • How do the concepts of universal design impact the work of engineers across multiple disciplines? • How do engineers focus redesign efforts to meet particular customers' needs? • How do engineers analyze a product to generate ideas for its redesign? • How do engineers model a system or product during the design process?	**Unit 3 Breakdown:** a. Interviewing Customers b. Interpreting Needs c. Identify and Describe the Need d. Characterize and Analyze the System (Disassemble) e. Confirm Functionality f. Generate Concepts g. Select a Concept h. Embody, Finalize and Share the Design i. Reverse Engineering in Context **Assessments:** **Individual/Formal:** Assessment 1 - Activity Diagram Assessment 2 - Function Table Assessment 3 – Metrics Assessment 4 – Benchmarking Assessment 5 – Customer Needs Analysis Assessment 6 – Circuits Assessment 7 – Measurement Tools Assessment 8 – Functional Models Assessment 9 – Brainstorming Assessment 10 – Pugh Charts Assessment 11 – Technical Drawings Assessment 12 – Verification Assessment 13 – Design Approaches Peer Assessment Self-Assessment **Group/Formal:** For each team: A technical drawing of the proposed design, with major dimensions and materials labeled For each team: A final report/proposal to management that includes all requirements
Unit 4: Understanding Data December/January Essential Questions: • Why do engineers use data when solving problems? • What techniques do engineers use to organize and represent data for decision-making and communication purposes? • What do chemical engineers do in their profession?	**Unit 4 Breakdown:** a. What is Chemical Engineering? b. Designing Coffee c. Analyzing Data d. Presentations and Extensions **Assessments:** **Individual/Formal:** Assessment 1 – Data Representation Memorandum Assessment 2 – Presenting Data **Group/Formal:** Presentation on chemical engineering technology, product, project, or job

Unit 5: Designing with Data January/March Essential Questions: • How do engineers decide which data to collect and how? • What techniques do engineers use to analyze, organize and represent data for decision-making and communication purposes? • What types of models do engineers use to characterize systems, and how do these models support system analysis?	**Unit 5 Breakdown:** a. Identify and Describe the Need b. Describe the Need c. Describe the Need, Part II d. Characterize and Analyze - Physical Model e. Designing with Data (Safer Buildings) f. Have We Fully Described the Need? g. Generate Concepts h. Select a Concept i. Embody the Concept j. Test, Evaluate, and Refine **Assessments:** **Individual/Formal:** Assessment 1 – Requirements and Constraints Assessment 2 – Design of Experiments Assessment 3 – Scaling Assessment 4 – Periodic Signals Assessment 5 – Standard Deviation Assessment 6 – Resonance Assessment 7 – Research Existing Approaches Assessment 8 – Data Analysis Assessment 9 – Cost Management Assessment 10 – Technical Reports Assessment 11 – Standards and Regulations Peer Assessment Self-Assessment **Group/Formal:** Final technical memo/report
Unit 6: Programming March/April Essential Questions: • How do engineers develop and implement programming code to accomplish projects and tasks? • What are some best practices for programming and why are they important? • What do electrical engineers do in their profession?	**Unit 6 Breakdown:** a. What is Electrical Engineering? b. Programming in Minibloq c. Programming in Arduino d. Controlling the Speaker System e. Presentation of Programs, Songs, and Electrical **Assessments:** **Group/Formal:** Functioning Electronic Circuit Playing Programmed Song Arduino Code Printout
Unit 7: Systems Engineering May Essential Questions: • How does understanding the system context aid the engineer in understanding the challenge? • Why does a systems challenge require complex teaming? • What are the ethical obligations of engineers?	**Unit 7 Breakdown:** a. Identify the Need b. Describe the Need - Systems c. Project Management - System d. Describe the Need - Subsystems e. Characterize and Analyze (Subsystems) - Programming f. Generate, Select and Embody Concepts - Subsystems g. Embody Concepts - Systems h. Test and Refine Concepts - Systems

	i. Finalize and Share the Design - Systems **Assessments:** **Individual/Formal:** Assessment 1 – Teaming Methods Assessment 2 – System Decomposition Assessment 3 – Team Notebooks Assessment 4 – Scheduling and Milestones Assessment 5 – Weighted Decision Matrix Assessment 6 – FMEA Assessment 7 – System Embodiment Assessment 8 – Concept of Operations Assessment 9 – Team Norms Assessment 10 – Technical Presentation Assessment 11 – Engineering Design Process Assessment 12 – Ethics and Safety Peer Assessment Self-Assessment **Group/Formal:** Design challenge rubric (launch performance) Presentation & Report